

Isotope hydrology of North Gujarat, India

S.K. GUPTA¹ and R.D. DESHPANDE¹

¹*Physical Research Laboratory (PRL), Ahmedabad 380 009, India*

Water isotopes of local precipitation and groundwater have been used as a tool for recharge estimation, determination of evaporation effects and a variety of other hydrological investigations [1]. One important application in natural waters is to estimate the extent of evaporation, both during the rainfall and during the process of groundwater recharge. The transpiration, being largely a non-fractionating process [2, 3] does not alter the isotopic composition of the recharging water during its passage through the soil/ vadose zone. But, transpiration does increase the salt content of the recharged water. Therefore, a combination of isotopic and ionic concentration variation in natural ground waters can be used to quantify the relative magnitudes of evaporation and transpiration.

Present study was undertaken to fill a gap in the database of isotopes in precipitation and groundwater from a region of India that is climatically transitional between arid desert region in the northwest and sub-humid region in the southeast. In this region, Radiocarbon (¹⁴C) dating of groundwater had indicated ages >35ka [4]. The ground waters in parts of the region also contain excessive fluoride and the isotopic study has been useful in identifying the origin of excessive fluoride concentration. In general, areas of high fluoride overlap areas with high electrical conductivity (EC). On the west flank of the Cambay Basin in the low lying belt linking Little Rann of Kachchh - Nalsarovar - Gulf of Khambhat, high fluoride and EC in shallow aquifers originate from evaporative enrichment. On the east flank of Cambay Basin, some high fluoride pockets are observed which are probably due to preferential dissolution of high fluoride bearing minerals. On this flank high fluoride is also associated with thermal springs. Within the Cambay Basin, alternating belts of low and high fluoride concentrations are ascribed to groundwater recharge during the past wet and arid climatic phases, respectively. This is based on groundwater radiocarbon age contours of ~20 ka overlapping the high fluoride belt.

Keywords: Water isotopes; North Gujarat; India; hydrology; evapo-transpiration; radiocarbon; fluoride.

References

- [1] I. Clark and P. Fritz, *Environmental Isotopes in Hydrogeology*, Lewis Publishers, Boca Raton and New York, 328 (1997).
- [2] U. Zimmermann, et al. *Isotopes in Hydrology*, IAEA, Vienna, 567 (1967).
- [3] H. Forstel, *Stable Isotopes*. Elsevier, Amsterdam, 503 (1982).
- [4] S.K. Gupta, et al., *Hydrogeo. J.*, (in press), doi: 10.1007/s10040-004-0389-2, (2005).